Job Loss Analysis

Control No: 2000246 **Status:** Final **Original Date 11/3/2010**
Last Date Closed: 11/31/11

Organization: Global Manufacturing
JLA Type: Global Mfg –Shared
Work Type: Technical-Process Engineering
Work Activity: High H2S in Fuel Gas Systems

Personal Protective Equipment (PPE)

☐ Goggles	☐ Hearing Protection	☐ Safety Cones/Barrier	☐ Welding Hood
☐ Face Shield	☐ Hard Hat	☐ Tagout/Lockout	☐ Gloves(Kevlar, rubber, leather)
☐ Safety Glasses	☐ Safety Boots	☐ Hi Viz Jacket	
☐ H2S Monitor	☐ Fire Resistant Clothing	☐ Long Pants/Trousers	☐ Other ie. Alky PPE.________________
		☐ Long Sleeve shirt	

Reviewers

Reviewer Name	Position	Date Approved
Michelle Johansen	Process Engineering Manager/Global PED JLA Development Team Leader	11/30/11

Development Team

Development Team Member Name	Primary Contact	Position
Bart Welch	CTN 938-4732	Amine and Sour Water BIN Leader
Amine BIN Team		Process Engineering and Amine Plant Operations (11)

Job Steps

No.	Job Steps	Potential Hazard	Critical Action
1	High H2S in Fuel Gas	1a.Environmental Exceedance 1b.If Fuel Gas is fed to H2 Plant, it can damage catalyst and shorten H2 Plant Runlength. 1c.Potential for personnel exposure to H2S around	1. Follow JLA steps listed below to diagnose and address abnormal behavior of H2S in Fuel Gas before regulatory or downstream impacts occur.

		process furnaces if there are fuel gas leaks.	
2	Develop Quick Reference Manual	1. Problem not identified in a timely manner and/or problem mis-diagnosed	Ideally, prior to issue 1a. Gather appropriate PFD's & System Drawings to understand how to follow from sample point back to sources. 1b . label drawings with locations of sample points and instrumentation (e.g. analyzers, flowmeters). 1c. Identify inherently sweet sources (e.g. Alky, Reformer) that bypass Amine treating, intermittent sources (e.g. column pressure controller vents, flare gas recovery) and sour sources to Amine fuel gas treaters,
3	Develop pre-built trend package (e.g. IndX, Process Book, Excel) with appropriate variables for troubleshooting high H2S in Fuel Gas	1. Problem not identified in a timely manner and/or problem mis-diagnosed	Ideally, prior to issue: 1a. Develop list of process variables needed. 1b.Build trends with ability to look at both short (~3 days) and long term (~1 month) timeframes. Set resolution so that spikes are not averaged out. 1c.Identify meters that are not working and have repaired as needed.
4	Identify and classify abnormal H2S readings	1. Behavior of trend can be used to narrow down root cause, failure to do so could lead to problem not being identified in a timely manner	1.Analyze H2S in Fuel Gas trend. Has there been a step change (e.g. normal 20 ppm H2S, now 50 ppm), creep (steady rise in H2S over time), spiky (sudden increases, possibly off-range, that come and go, and/or may be flowrate dependent)?
5	Verify Deviation	1. Analyzer results may be wrong, failure to identify early may waste resources	1a.Check Analyzer Calibration, verify Analyzer is getting adequate process flow 1b.Drager or pull bag sample 1c.If other analyzers (at individual Absorbers or on Fuel Gas to specific furnaces) are available, compare against CEMS (Continuous Emissions Monitors)
6	Narrow down to Absorber or Regenerator	1. Failure to do so could lead to problem not being identified in a	1a.If multiple absorbers, check sweet gas from each (via analyzer or drager) to narrow down issue to single absorbers. 1b. If all absorbers on a regen circuit are abnormal, problem is likely in the Regeneration section.

		timely manner	1c. If no Absorbers are abnormal, problem is likely from a source that is not amine treated
7	Step change or creep, regeneration section	1. Control philosophy may be driving a reduction in steam due to bad measurement	Poor regeneration of amine/inadequate steam to reboilers: Control schemes include steam to amine circulation ratio, controlling steam to a lean loading (lab) target, overhead temperature target. Depending on type of control, do the following: 1a.Verify lean loading with main lab, check lab chemicals used for lean loading and amine strength titrations 1b. Compare steam flow indication to steam controller valve position, does it match historical? 1c.. Compare amine flow indication (used in ratio controller) to valve position of rich amine to Regenerator, does it match historical? Compare Lean and Rich flowmeters, has the balance changed? Note, Rich flows usually up to ~5% higher due to absorbed H2S). 1d. Has Regenerator pressure increased? Higher pressure will raise column temperatures without maintaining equivalent stripping, higher pressure requires more steam. 1e. Are HSS low (less than ~1wt% equivalent amine)? HSS actually improve stripping and removing HSS or neutralizing with caustic may require more steam to maintain stripping efficiency. 1f. Is Reboiler choked/flooded/fouled? – check steam valve position, check reboiler chest pressure (if control valve upstream of reboiler), check operation of condensate drum or steam trap.
8	Step change or creep, regeneration section	1. Contamination of amine can result in High H2S in Fuel Gas	1a. Check for Lean/Rich Exchanger leak • Does increasing steam rate have no effect on Lean Loading? • Sample for H2S loading on Lean in and out of exchanger • Look for change in exchanger dT (may be too small to see) 1b. Caustic contamination can hinder stripping of H2S. Check for change in bound amine (Total minus Free Amine), if ~equal, analyze for sodium, high sodium and no bound amine could indicate over-neutralization

			1c. Wrong amine delivered – check Certificate of Analysis (COA), send sample to supplier to speciate amine
9	Step change, Absorber	1.Amine Flowrate too low, Sour Gas flowrate too high or composition of Sour Gas (H2S and CO2) overloading Absorber may saturate amine (high Rich Loading) and make it unable to absorb all H2S	1a. Compare amine flowrate to historical for similar sour gas feedrate to tower, if normal: • Balance flowmeter to Absorber with high H2S against other system flowmeters, compare flowrate to historical valve positions • Check Rich Loading if calculation available or sample amine for rich loading (use Best Practice procedure on SRU/Amine BIN site) 1b. Check internal TI's, if available, for indication of temperature bulge abnormally high in column 1c. Sour gas flow or concentration • Look for step changes in Absorber gas rate, if none, check flowmeter via balance (if possible) and/or compare flow vs valve position (may need to account for Absorber pressure and Fuel Gas Header pressure when looking at historical data) • Check for composition change in Sour Gas feed to Absorber by trending offgas rates from individual sources (Coker, FCC, etc.) to see if a unit coming online, increasing rate, or venting excessively
10	Step change, Absorber or Regenerator	Some system-wide issues may only appear to affect one Absorber if other Absorbers are running below design. 1. Low amine strength may saturate amine (high Rich Loading) and make it unable to absorb all H2S 2. High amine temperature decreases ability of amine to absorb	1.Verify amine strength, cross-check with main lab, check lab chemicals being used for strength titration. If unit is struggling to maintain amine strength, • Check water balance - reboiler tube leak could be diluting amine, purge from reflux loop may be out of balance with makeup water • Is level rising in sump or relief drum? E.g. sample station valve open, pump case drain open • Is skimming flash drum excessive, consider checking skim to verify it is mostly oil and not amine • Check for adequate regen reflux (low reflux promotes carryover of amine) • Check for excessive carryover of amine out of absorber to sweet gas k.o. (if it doesn't drain back to amine system) or fuel gas system • To mitigate, increase circulation rate to

		H2S	Absorber(s) 2.Compare Amine temperature to Absorber(s) vs. historical, if high: • Are Lean Amine Cooler Finfans on and operating well? Could be mechanical issue (e.g. slipping belt, bad motor) or finfans were shutoff at night or during rain and not turned back on • If Coolers are Cooling Water, check CW flow and/or temperature, verify any bypass is closed • Check Lean/Rich exchanger performance, fouled exchanger puts extra load on Lean Coolers • Is Amine rate too high and overloading cooler? Possible flowmeter issue, balance against other flowmeters and/or compare flowrate to historical valve positions • Is Amine concentration too high? Higher strengths worsen the heat transfer properties of the solution
11	Spikes, Absorber	1. Foaming absorbers can lead to spikes in H2S in the treated gas, additionally, may carryover amine to Fuel Gas system which plugs furnace burners, may carryunder hydrocarbon to Regeneration section which may upset Regenerator and/or downstream SRU's.	1a. Check if Absorber is foaming or flooding: • dP • Erratic bottoms level • Carryover to k.o. drum • Check flash gas rate off Rich Amine Flash Drum as indication of hydrocarbon carryunder • Check sightglasses for oil • Check hydrocarbon analyzer on acid gas, if available • Check flash gas flowrate off Rich Amine Flash Drum for indication of H/C carryunder • Evaluate response to antifoam injection 1b. Troubleshoot foaming by addressing solution cleanliness (antifoam addition, filtration, carbon treating, hydrocarbon contamination, surfactant contamination). 1c. If symptoms do not respond to antifoam and occur consistently at the same rates, column internals may be damaged or plugged, consider column scan.
12	Spikes, Absorber	1. Swinging offgas rates from upstream process	1a.Check for composition change in Sour Gas feed to Absorber by trending offgas rates from individual sources (Coker, FCC, etc.) to see if offgas rate from a unit is swinging.

		units can change composition and intermittently overload amine	1b.Check Rich Loading calculation if available 1c. Check if Acid Gas flowrate from Regenerator is swinging
13	Spikes, Regenerator	1. Foaming/flooded regen can lead to swings in H2S in Fuel Gas, additionally will swing rate to SRU, unit upset, possible shutdown of SRU, possible catalyst damage	1a.Check if Regenerator is foaming or flooding: • Check dP, if no dP, bottoms temperature can be used as a trend of bottoms pressure • Erratic bottoms level and/or erratic Reflux Drum level (consider trending valve positions) • Variable acid gas rate, liquid in SRU k.o. drums 1b.Troubleshoot foaming by addressing solution cleanliness (antifoam addition, filtration, carbon treating, hydrocarbon contamination, surfactant contamination). 1c. If symptoms do not respond to antifoam and occur consistently at the same rates, column internals may be damaged or plugged, consider column scan.
14	Step change, Absorbers normal	1. Direct contamination of Fuel Gas system is possible due to rerouting of sour gas streams or from a normally sweet stream containing H2S due to unit upset	Check for sour gas bypassing to sweet gas 1a.Verify each absorber, if clean, then P&ID system to look at sweet gas sources, start dragering upstream 1b.Have a diagram of all sources that go into fuel gas system upstream of analyzer
15	Step change, Absorbers normal	1. Possible (but unlikely) that Natural Gas make-up to Fuel Gas system is contaminated with H2S	1.Sample Natural Gas Makeup for H2S
16	Unresolved	1. Issue will continue un-addressed	1.Contact Amine Treating Subject Matter Experts and/or Amine vendor (e.g. Huntsman) for additional Technical Support